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ABSTRACT

This paper describes the use of a software tool designed to facilitate the analysis of a qualitative research study that required the examination of a large quantity of unstructured text. The Metamorph software program was selected because of its unique nature as a text retrieval tool. The program is able to manipulate data using a systematic structure of pattern matching and set logic. Metamorph was used in a study of collaborative problem solving among 96 high school students using the Moonbase America space science simulation. Metamorph was used to analyze the student logs through its concept-based text retrieval system. As a tool, it allowed the researcher to move through every step of the data refinement process. (Contains 21 references.) (SLD)

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The Use of Technology to Facilitate the Analysis of a Qualitative Research Study

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1

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Qualitative research often requires the analysis of large quantities of unstructured data. Research questions are addressed using data in the form of interviews, observations, field notes, journals, video and audiotapes. Qualitative researchers employ several major analysis tasks which includes the identification of individual words, word frequencies, coding key words, and identifying emerging concepts. As computer software becomes more sophisticated its use in qualitative research is becoming more common. There has been a rising trend for researcher to take advantage of qualitative analysis software to facilitate the complex and tedious task of qualitative analysis. "Qualitative analysis programs are software packages developed explicitly for the purpose of interpretative analysis using data that consists of narrative text." (Tesch, 1990, p. 147). Well known examples include programs such as Nud*ist, Atlas/ti, Ethnograph, HyperRESEARCH, and Qualpro.

Qualitative data analysis requires the researcher to sift through large quantities of text to develop taxonomies, explicate themes, formulate hypotheses and/or generate support for triangulation. Unfortunately, most software programs do not provide the liberty to freely search multitudes of unorganized textual data. Most computer software programs tend to be highly structured posing a problem to the qualitative researcher trying to fit unstructured data into a highly structured computer environment.

This paper presents the use of a specific software tool designed to facilitate the analysis of a qualitative research study that required examination of a large quantity of unstructured text. Metamorph, a software program, was selected because of its unique

nature as a text retrieval tool. This program is able to manipulate raw (ASCII) data without imposing classical, Boolean logic. Instead it is built on a systematic structure of pattern matching and set logic. Not only is this software able to search and find specific words within unstructured text, it uses a thesaurus to find meaning within contextual phrases.

> Metamorph is an extremely powerful search-and-retrieval program that uses artificial intelligence techniques to find not only the word(s) you ask for, but any form of that word, or any other word that means the same thing.... We know of no other program that can replicate those features, and they are the primary reason for a qualitative researcher to use Metamorph: It has the potential for serious advances in qualitative data analysis—especially the searching aspects. (Weitzman & Miles, 1995, p. 28).

Metamorph accomplishes its unique search and retrieval capability using set theory in conjunction with special pattern matchers, a complete Thesaurus, morpheme processing, and a method of pattern matching criteria to intelligently locate relevant, meaningful responses in textual material. The searches are accomplished at the rate of up to 70 MBytes per second for linear search (Thunderstone, 1999).

Unlike many data analysis programs, Metamorph is a tool that can be utilized throughout the research process. It provides a way for researchers to handle large quantities of data that might otherwise appear intimidating. Overlooking significant literature when searching through vast amounts of information is often a concern. Because of Metamorph's efficient and thorough search engine it is possible to search

through all the available article abstracts found on CD-ROM and review the selected articles.

After the initial review of literature, Metamorph can continue to be used at various stages of data analysis. Qualitative data are entered into the computer as ASCII text files. These data can take the form of field notes, text transcriptions of audiotapes, subjects' and researcher's journals, etc. Initial data analysis can begin once these files are available to the Metamorph computer program.

Data query can be done in a natural language format. Metamorph is built on semantic relationships providing the researcher with the flexibility to interact with her data using the language of the participants. To understand how Metamorph accomplishes this task think about matching all query word items against all possible thesaurus entries. After making list sets of all thesaurus combinations, Metamorph rapidly scans the text files for corresponding matches. When a "hit" is found it is highlighted and displayed in context on the monitor for the researcher to review. This provides immediate information to the researcher on how successful the query was and leads the researcher to utilize higher level thinking strategies to uncover subsequent findings or in guiding the rephrasing of the query. In essence, Metamorph allows the researcher to have a conversation with his/her data.

Preliminary broad groupings can be saved into separate text files. These files can be further analyzed to facilitate the refinement of data groups into thematic relationships, domain categories or matrices building. In multiple case study research, within-site files can be queried to develop insights into cross-sites' similarities and differences. (Shapiro, Clemente, Anglin, & Richard, 1990, p. 31).

Metamorph was selected as the qualitative analysis tool to be used in a complex qualitative study attempting to determine the formation of collaborative problem solving in Moonbase America, a large-scale space science simulation. Moonbase America was a simulation of a moon-based space station where 96 high school students grades 8-12 lived, worked, controlled, and maintained their environment without adult intervention for six continuous days and nights. Their mission was to discover what life would be like in a similar world on a lunar outpost. To make the simulation more realistic, the students' only contact with the outside world came via telephones, video cameras and computers. Much of the students' time was spent communicating with each other and with the outside world. Literally thousands of complex interactions occurred during the simulation.

The Moonbase simulation was completed before the research study was conducted. For this reason the investigation was retrospective in nature much like an archeological dig. Data could be gathered only from what remained of the project. Predetermined perimeters could not be imposed. Although this was a limitation to the investigation, rich information documenting the experience had been accumulated. Journals were kept by 96 students for each of the six days of the simulation. Ongoing video footage captured the students' activities during the course of the simulation. Six, one-hour satellite programs had been videotaped and transmitted each day of the simulation. (Shapiro, 1994)

A major phase of analysis concentrated on the students' journals that "told the story of Moonbase America". There were 96 students submitting their journal entries for six days. In other words there were 576 separate files to be organized and analyzed. The

entries range in size from several sentences to multiple pages. No structure was imposed on the students; therefore, the nature of the logs varied. Because of the vastness and complexity of this data set, a great deal of computer manipulation took place. The student logs were all converted into ASCII text. Identification codes were entered for each log entry, which included the student's initials, team category, and date of log entry. The logs were then compiled into a single document, arranged according to team category, and printed into a book form with page numbers. This made the student logs available in both print and digital form.

Digitally, the student logs were queried using Metamorph concept-based text retrieval system. The researcher was attempting to find an intersection of meaning between her search query and the body of information within the student journals. In its own way Metamorph attempted to understand the query, represent its understanding, and retrieve relevant responses in context from the data. Metamorph was able to scan vast amounts of information finding matches or "hits" of concepts and ideas. The Metamorph "hit" was the actual word(s) or a thesaurus form of the word(s). This information was presented on the computer monitor in its original context with the "hits" highlighted. Once the information was presented on-screen, it was possible to mark a block of text in its original context and save it to an appendable file. Different concepts were saved in separate files reducing the data to manageable clusters without losing the original context of the statement. This process allowed rapid, unstructured information searching, in-context judgment of information relevance, and grouping of selected information that was saved in ASCII format. Metamorph allowed the researcher to enter collaborative problem solving concept and interact with the data output. It was possible to search for

actual words and phrases and see the emergence of categories and themes related to collaborative problem solving.

Another portion of inquiry within this study was Rogers and Kincaid's communication network analysis used to observe the flow of information and strategic steps taken during collaborative problem solving. "A communication network consists of interconnected individuals who are linked by patterned flows of information" (Rogers & Kincaid, 1981, p. 75). The network analysis was attempted by constructing matrices that charted the communication network that occurred during each critical incident. Each incident was subdivided into collaborative problem-solving categories relating to individual and group behavior. Metamorph was particularly helpful in searching through the quantities of text looking for particular names, specialty area teams and critical events. Selecting appropriate portions of texts and saving this information into files grouped by category helped sort information in a way that made this near impossible task manageable. Preliminary broad groupings were saved and further analyzed to facilitate the refinement of data groups into thematic relationships, domain categories and matrices building.

Metamorph was able to facilitate the qualitative research process without sacrificing attention to detail. This software tool allowed the researcher to carefully walk through every step in the data refinement process. During the qualitative analysis it was the researcher who decided what to keep and what to eliminate, the researcher who determined the categories and domains, and at all points in the process it was the researcher who extracted meaning from the data. It appeared that Metamorph's greatest contribution to this qualitative study was its ability to actively involve the researcher in

natural language querying and to speed process of dealing with large amounts of unstructured information.

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